SILVIA MONICA FERARU*

THE COMPARISONS BETWEEN THE FORMANT VALUES IN FRENCH AND ROMANIAN

INTRODUCTION

The Romanian language is an Indo-European language from the italic group and it also makes part of the oriental subgroup of the Romanic languages. The Romanic group includes Spanish, Portuguese, French and Italian. The principal background of words from Romanian language is 60–66% of Latin nature but it also inherited influence from German nature (*cartof* – Kartoffel – potato; *bere* – Bier – beer), influence from Greek nature (*ófelos* – use, *prósfatos* – fresh), influence from Magyar nature (*város* – city, *fogadni* – promise), influence from Turkish nature (*kahve* – coffee, *papuc* – slipper), etc.

The vocabulary of the Romanian language includes Romanic elements (71.66%), Slavic elements (9.18%), Bulgarian elements (2.6%), Russian elements (1.12%), Serbian-Croatian elements (0.85%), Ukrainian elements (0.23%), Polish elements (0.19%), German elements (2.47%), Magyar elements (1.43%), Turkish elements (0.73%), English elements (0.07%), uncertain elements (2.71%) and onomatopoeias (0.19%) [13].

The Romanian language has various dialects which have minor difference of pronouncing and of vocabulary; these dialects are Moldavian, Muntenian, from Oltenia, from Banat, Transylvanian, and from Maramureş.

The intensity accent of Romanian language can determine different meaning like "happy" (véselă) and "dishes" (vesélă) or "kids" (copíi) and "xeros copy" (cópii). This feature constraints the emotion representation, compared to other languages, like the French. Indeed, in French, the accent on the last syllable and in this case it doesn't have different meaning, while in Magyar, Finnish, Japanese language the intensity accent doesn't exist.

THE SPEECH DATABASES

A speech database is a collection of files with sounds, structured after its own purpose [14]. An emotional speech database is a corpus of speech pronounced under different emotional states. Speech emotions analysis and the recognition can

* **Silvia Monica Feraru**: Scientific Researcher; Romanian Studies.

DACOROMANIA, serie nouă, XVII, 2012, nr. 2, p. 124–130

be used for voice training by actors, by disabled people for learning to improve communication, moreover for human-computer speech interaction, for security, for medical applications, for video-games and interactive TV, etc.

The English and German are the most dominant languages used in the emotional speech databases and the most common studied emotions are: anger, happiness, fear, disgust, surprise, boredom, and joy.

In this paper we focus on the analysis for the Romanian and French language. The analysis was made by [2] on the PFC corpus for French and by [5] on SRoL corpus for Romanian language. Below we present the relevant information about the PFC and SRoL corpora.

The PFC corpus (after [2]) contains the recordings covering a wide French-speaking territory, from 10 speakers with varying educational and professional backgrounds. The speaker read 100 words and 20 sentences from a list.

The SRoL corpus (after [8]) contains the sounds of the Romanian language (the vowel files, the consonants files, the diphthongs, the triphthongs, the specific sounds of the Romanian language), short sentences/phrases segments with different emotional tones, the phonetic aspects (in the conjunction with the semantic aspects) in the sentences with the double issue in Romanian, the analysis tools made by our team, the documentation. Professor H. N. Teodorescu conceived the research and the methodology. The database contains recordings from the speakers, mostly from NE Romania, educated and without manifest pathology. The analysis was made on the recordings from 7 phrases pronounced with neutral tone and three emotional states (joy, fury and sadness), by 19 speakers, 8 of them female and 11 male speakers. The sentences are: 1. *Vine mama*. (Mother is coming.) 2. *Cine a făcut asta*? (Who did that?) 3. *Ai venit iar la mine*. (You came back to me.) 4. *Aseară*. (Yesterday evening.) 5. *Omul meu îl lucra*. (My man done it.) 6. *Îţi vei câştiga locul dorit.* (You will get the desired place.) 7. *Oricum îţi poţi câştiga locul dorit*. (Anyway, you can get the desired place.). Each speaker pronounced a sentence at least three times following the recording protocol. The sentences have been annotated on the phoneme, the syllable, the word, and sentence level using Praat software.

So far there is no standard method of the emotional annotation. It is difficult to distinguish the boundary between phonemes. In the figure shown below (figure 1) we exemplify an annotation, for the phrase "Mother is coming" pronounced with the state of joy, by speakers 55555.

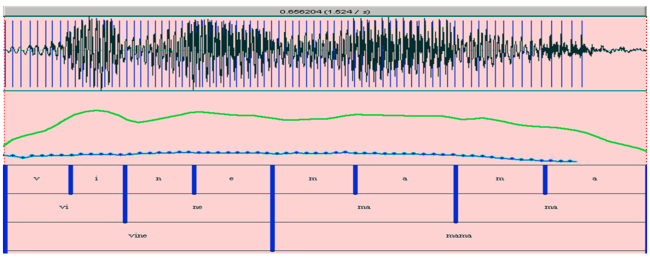


Figure 1. *An example of the annotated sentence / Mother is coming / – Praat software.*

Every person who made the recordings completed two type of the documentation protocol (*the speaker's profile* – contains the linguistic, ethnic, medical, educational, professional information and *a questionnaire* – contains the health information of the speakers: http://www.etc.tuiasi.ro/sibm/romanian_spoken_language/ro/protocol_nou.htm).

The persons were previously informed about the objective of the project. The speaker signed an informed consent in accordance with to the Protection of Human Subjects Protocol to the U.S. Food and Drug Administration and with Ethical Principles of the Acoustical Society of America for Research Involving Human Subjects.

The recordings were made using the GoldWave application, with a sampling frequency of 22050 Hz. After the sentences were recorded, they were validated by a validation committed. The sentences which did not express the emotions well enough have been excluded from the analysis. The voice signal recorded can be viewed in figure 2.

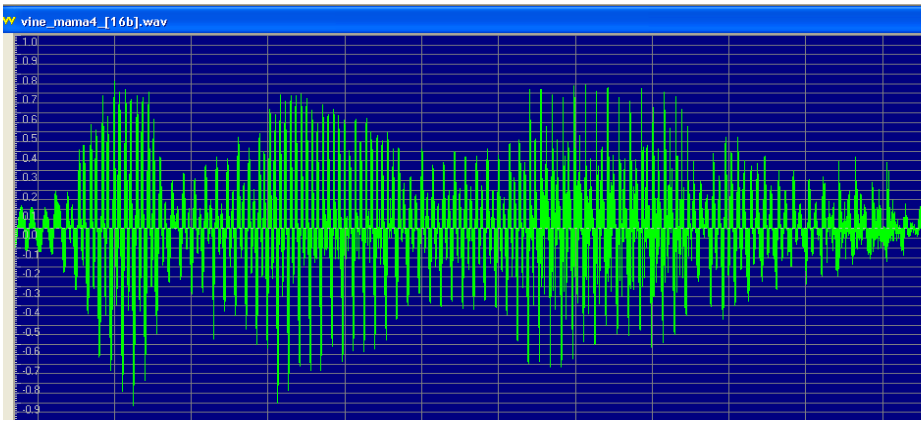


Figure 2. *Example of voice signal – GoldWave software.*

THE ANALYSIS AND THE RESULTS

We obtained the values of the formants, F1 and F2 using Praat software, for the Romanian language. In this study we analyzed only the cardinal vowels "*a",* "*i*" and "*u*". The F1 formant values (see table 1) are "higher" in Romanian than in French for neutral tone for the vowels "*i*" and "*u"* comparing the results obtained by [1], [3], and [5]. The F2 formant values for the vowel "*u*" are "higher" in French than to Romanian according to [1], [3–5]. For the vowels "*a*" and "*i*" the F2 formant values are "higher" in Romanian than in French by [1], [5] and "smaller" by [1], [3], [4]. The emotional expressiveness in French and Romanian languages are similar, the variation of F1 and F2 formants values being insignificant.

Depending on the mode of the articulation of vowels, the researchers Makarova and Petrushin concluded that the higher values correspond to more open articulations [6].

Table 1

The mean F1–F2 formants values for French (after [1]) and Romanian (after [3], [4], [5]).

	French		Romanian	
Vowels	F1 Goudbeek, Goldman, Scherer 2009	F2 Goudbeek, Goldman, Scherer 2009	F1 Avram 1963/ Teodorescu 1995/ Teodorescu, Zbancioc, Feraru 2011	F2 Avram 1963/ Teodorescu 1995/ Teodorescu, Zbancioc, Feraru 2011
a	756	1391	703 / 640 / 714	1278 / 1192 / 1481
i	277	2321	317 / 235 / 349	2225 / 2144 / 2329
u	300	1863	339 / 280/ 427	850 / 702 / 1233

Speech communication is rich and subtle, it not only transfer the language information as well as the information about the personality and emotional state of the speaker. The emotion is a social environment and adapted motivational response. The formant analysis is affected by the emotional state [5]. For example, for the Romanian language the area of the vowels triangle is bigger for the joy and for fury states and smaller for neutral tone and sadness state. The formants F1 and F2 values for the vowels are a "little higher" for the female than the male.

We computed the standard error for the values of the formats F1 and F2, for the vowels "*a*", "*i*", and "u". In figure 3 the values of the standard error for the F1 formant are represented, for male and female speakers, depending on the emotional states, for the Romanian language.

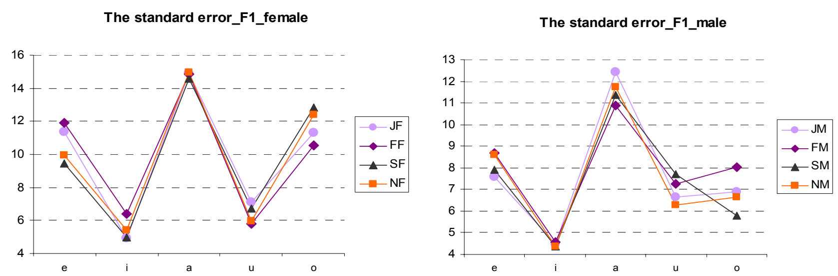


Figure 3. *The standard error of F1 for the vowels e, i, a, u and o, for the Romanian language.*

There are significant variation of the standard error for the F1 formant values comparing the vowel "a" with the vowels "i" and "u", both female and male speakers. The standard errors of the F1 values for the vowel "*u*" have variability

depending on the emotional state, for the male speakers; the smaller for neutral tone and the higher for the sadness.

We computed also the variation coefficient of the F1 and F2 formants values, for female and male speakers, for the Romanian language. The variation coefficients of the F1 values are shown in the table 2.

Table 2

The variation coefficient of F1 values, for female and male speakers, for the vowels: e, i, a, u and o, for the Romanian language.

Vowels	The variation coefficient values of F1			
	Joy	**Fury**	**Sadness**	**Neutral**
a	9.95 / 8.23	10.72 / 9.36	9.57 / 9.24	9.92 / 9.88
e	6.55 / 6.52	8.19 / 6.70	7.36 / 6.57	7.81 / 6.69
i	9.74 / 9.12	9.68 / 7.44	10.33 / 8.53	10.33 / 8.76
u	7.85 / 7.88	6.44 / 8.14	7.77 / 9.50	7.05 / 8.22
o	9.87 / 7.07	9.31 / 8.21	12.47 / 6.14	11.90 / 7.19

A general observation is that the variability of the emotional speech is higher for the female comparing with the male speakers. From all three emotional state analyzed, the sadness state has the higher variation of the variation coefficient of F1 values for the Romanian language. We think that the sadness is often expressed by the speakers in various ways than other emotions. Petrushin [15] made a study regarding the recognition of the own emotions and he concluded that the anger, and the sadness was better recognized than happiness.

A vowel triangle in the formant space F1–F2 is a schematic representation of the vowels. The vowel triangle corresponding to the "cardinal vowels" is language dependent [16]. For the most of the language the form is a triangle [17]. The cardinal vowels are "*a", "i",* and "*u*". In [18] the researchers said that the closed vowels are more opened (higher values of F1). They observed that the vowel triangle is much larger in French than in English. They also noticed that the vowel area size increases with increasing the child age, for the French. The three vowels "i", "*a*" and "*u*" are more extreme in French, after H. Fujisaki, and T. Kawashima [19].

Conclusions

A positive emotion (joy, pleasure) leads to a raised F1 value, and a negative emotion (sadness, anger) to a lower F2 value according to [1]. The positions of formats reflect the emotion information. We believe that F1 and F2 formants values contain information which can indicate the features about the emotional state. In this study the statistic analysis is done with no reference to the position of the phoneme (beginning / the end of the word, accented / non-accented syllable).

A general conclusion is that the similarity of emotion representation in Romanian and French languages is preserved [7].

Acknowledgement: *This paper is supported by the Sectoral Operational Programme Human Resources Development (SOP HRD), financed from the European Social Fund and by the Romanian Government under the contract number POSDRU/89/1.5/S/56815.*

REFERENCES

1. M. Goudbeek, J. Ph. Goldman, K. R. Scherer, *Emotion dimensions and formant position*, Interspeech, 2009.
2. C. Woehrling, Ph. Boula de Marreuil, *Comparing Praat and Snack formant measurements on two large corpora of northern and southern French*, Interspeech 2007.
3. A. Turculeț, *Introducere în fonetica generală şi românească*, Iaşi, Casa Editorială Demiurg, 1999, p. 168.
4. H. N. Teodorescu, M. Zbancioc, M. Feraru, *Statistical characteristics of the formants of the Romanian vowels in emotional states*, 3 International Conference on Speech Technology and Human-Computer Dialogue SPeD 2011, Romania, ISBN: 978-1-4577-0440-6, pp. 1–10, http://ieeexplore.ieee.org/xpl/mostRecentIssue.jsp?punumber=5929232
5. H. N. Teodorescu, M. Zbancioc, M. Feraru, *The analysis of the vowel triangle variation for Romanian language depending on emotional states*, ISSCS 2011 Conference, Romania, ISBN: 978-1-61284-944-7, pp. 1-4, http://ieeexplore.ieee.org/xpl/freeabs_all.jsp?arnumber=5978727
6. V. Makarova, V. A. Petrushin, *Sonorant segment quality in Russian emotional speech*, ICPhS, Saarbrücken, 2007, pp. 2129–2132.
7. H. N. Teodorescu, M. Feraru, *A study on Speech with Manifest Emotions*, in Lecture Notes in Computer Science, vol. 4629, Springer Verlag, 2007, pp. 254–262.
8. The SRoL corpus *Voiced Sounds of the Romanian Language*, in H. N. Teodorescu, M. Feraru, M. Zbancioc, R. Luca, D. Trandabăț, L. Pistol, I. Pavaloi, http://www.etc.tuiasi.ro/sibm/Romanian_ spoken_language/index.html
9. W. Rodriguez, H. N. Teodorescu, F. Grigoraş, *A fuzzy information space approach to speech signal non-linear analysis*, in "International journal of intelligent systems", XV, 2001, pp. 343–363.
10. H. N. Teodorescu, *Metodologie pentru constituirea şi analiza unui corpus adnotat de semnale vocale – cazul SROL*, ConsILR 2010, Bucureşti, 6–7 mai. Editori: A. Iftene, H. N. Teodorescu, D. Cristea, D. Tufiş, Iaşi, Editura Univesității "Al. I. Cuza", 2010, pp. 13–22.
11. S. M. Feraru, H. N. Teodorescu, M. D. Zbancioc, *SRoL – Web-based Resources for Languages and Language Technology e-Learning*, in "International Journal of Computers, Communications & Control", V, 2010, nr. 3, pp. 280–290.
12. H. N. Teodorescu, *AI tools for speech analysis*, EEC conference, WSEAS Press, 2010, p.15.
13. M. Sala *et. al*., *Vocabularul reprezentativ al limbilor romanice*, Bucureşti, Editura Ştiințifică şi Enciclopedică, 1988, pp. 19–79.
14. D. Ververidis, C. Kotropoulos, *A Review of Emotional Speech Databases* (http://poseidon.csd.auth.gr/LAB_PEOPLE/Ververidis/Ververidis_PCI_2003.pdf).
15. Valery A. Petrushin, *Emotion recognition in speech signal: experimental study, development, and application*, ICSLP 2000, Beijing, China, October 16–20.
16. http://www.yek.me.uk/vowels.html
17. P. Skandera, P. Burleigh, *A Manual of English Phonetics and Phonology*, Tübingen, Gunter Narr Verlag, 2005, pp. 33–34.

18. C. Dodane and J. Al-Tamimi, *An acoustic comparison of vowel systems in adult directed-speech and child-directed speech: evidence from French, English & Japanese*, 16th International Congress of Phonetics Sciences, 6–10 August 2007, http://www.ddl.ish-lyon.cnrs.fr/fulltext/Al-Tamimi/Dodane_&_Al-Tamimi_2007_ICPhS_ article. pdf
19. H. Fujisaki, and T. Kawashima, *The roles of pitch and higher formants in the perception of vowels*, 1968, IEEE Trans. Audio. Electroacoust, vol. 1, 1968, pp. 73–77.

Abstract

The paper is focused on the values of the formants F1 and F2 for the French and Romanian language in order to notice the similarities between the two languages. We are studying the formants' position in both languages. The analysis was made on the PFC corpus for French by M. Goudbeek, J. Ph. Goldman, K. R. Scherer and on SRoL corpus for Romanian language by the author in the team at the initiative and the guidance of the professor H. N. Teodorescu.

Keywords: *formant analysis*, *emotional speech database*, *emotional state.*

Romanian Academy
Iaşi, Romania
monica.feraru@iit.academiaromana-iasi.ro